

Giovanni Pasini* & Alessandro Garassino**

Studies on Permo-Trias of Madagascar. 9.
Halicyne mamoroi n. sp. (Crustacea, Cycloidea)
from the Lower Triassic (Olenekian) of
Ambilobe region (NW Madagascar)

Abstract - Brambilla *et al.* (2002) reported for the first time the presence of cycloids from the Lower Triassic (Olenekian) of NW Madagascar. Later, Pasini & Garassino (2003) described, on the basis of a new specimen, some morphological characters of *Halicyne gondwanae* Brambilla, Garassino, Pasini & Teruzzi, 2002, giving its interpretative reconstruction. The present study describes *Halicyne mamoroi* n. sp. (order Cycloidea Glaessner, 1928, family Cyclidae Packard, 1885), discovered in the Ankitokazo Basin. At present, there are two species of *Halicyne* from Madagascar and Gondwana.

Key words: Crustacea, Cycloidea, Lower Triassic, NW Madagascar.

Riassunto - Studi sul Permo-Trias del Madagascar. 9. *Halicyne mamoroi* n. sp. (Crustacea, Cycloidea) nel Triassico inferiore (Olenekiano) della regione di Ambilobe (NO Madagascar).

Brambilla *et al.* (2002) hanno segnalato per la prima volta il rinvenimento di crostacei cicloidei nel Triassico inferiore (Olenekiano) del Madagascar nordoccidentale. Successivamente, Pasini & Garassino (2003) hanno descritto, sulla base di un nuovo esemplare, alcuni caratteri morfologici di *Halicyne gondwanae* Brambilla, Garassino, Pasini & Teruzzi, 2002, fornendone una ricostruzione interpretativa. Viene ora descritta *Halicyne mamoroi* n. sp. (ordine Cycloidea Glaessner, 1928, famiglia Cyclidae Packard, 1885), rinvenuta nel Bacino di Ankitokazo. Attualmente, sono due le specie appartenenti ad *Halicyne* provenienti dal Madagascar e dal Gondwana.

Parole chiave: Crustacea, Cycloidea, Triassico inferiore, NO Madagascar.

Introduction

Mamoro, tributary of the Ifasy River, is located at the middle of the famous fossiliferous outcrop within the Ankitokazo Basin (Diego Suarez province, Ambilobe region, NW Madagascar). In this area, the field collecting in 1989 by the Sezione di Paleontologia degli Invertebrati del Museo di Storia Naturale di Milano with the

*Museo Civico dei Fossili di Besano, Via Prestini 5, 21050 Besano (Varese), Italy,
e-mail: juanaldopasini@tiscali.it

**Museo Civico di Storia Naturale, Corso Venezia 55, 20121 Milano, Italy,
e-mail: a.garassino@tin.it

cooperation of J. Rasoanaivo, Director of Geological Service of Madagascar, yielded many invertebrate specimens, studied by the Sezione di Paleontologia degli Invertebrati del Museo di Storia Naturale di Milano (Alessandrello & Bracchi, 2005, as the latest reference) with the co-operation of some foreign institutes for the study of conchostracans (Yanbin *et al.*, 2002) and limulids (Hauschke *et al.*, 2004). The studied specimen was discovered in the typical faunal assemblage of the Ankitokazo Basin, including invertebrates (decapod and thylacocephalan crustaceans, annelid worms, cephalopods, bivalves, and gastropods) and vertebrates (many fishes, some amphibians, and rare semiaquatic reptiles). As reported by Garassino & Pasini (2002) the faunal assemblage of the Ankitokazo Basin dates back to the Lower Triassic (Olenekian).

Material

The present study is based on a single specimen, preserved as inner cast in part and counter-part, inside a small flattened subovoid non-calcareous nodule, in association with some ostracod remains, coming from eroded beds of an alternation of shale-clays, shales and sandstones.

The studied specimen is deposited in the palaeontological collection of the Museo di Storia Naturale di Milano (MSNM).

Systematic Palaeontology

Class Maxillopoda Dahl, 1956
 Subclass Halicyna Gall & Grauvogel, 1967
 Order Cycloidea Glaessner, 1928
 Family Cyclidae Packard, 1885
 Genus *Halicyne* v. Meyer, 1844

Type species: *Limulus agnotus* v. Meyer, 1838.

Stratigraphic range: Carboniferous (upper Mississippian – middle Pennsylvanian) – Middle Triassic (Muschelkalk).

Occurrence: United States (Illinois, Montana), Europe (France, Germany), Madagascar.

Included species: *H. agnota* (v. Meyer, 1844), ?*H. plana* (Müller, 1955), *H. ornata* Trümpy, 1957, *H. max* Schram, Vonk & Hof, 1997, *H. gondwanae* Brambilla, Garassino, Pasini & Teruzzi, 2002, *H. montanaensis* Schram, Boere & Thomas, 2005 (from Schram *et al.*, 2005).

Halicyne mamoroi n. sp.

Figs. 1-6

Diagnosis: subcircular carapace shield with strong papillose surface; underside of carapace with strong body segments and gill lamellae; rostral plate well developed anteriorly truncated with small central rostrum, bearing four? rounded bosses;

anterior post-optic bulge extending in a subtriangular gut in median and posterior parts; distinct rounded optic notches antero-laterally with rounded eyes; margin of carapace folds to form a well developed submarginal rim; elongate walking legs.

Etymology: from Mamoro outcrop where the studied specimen was discovered.

Holotype: MSNM i26555 a-b.

Type locality: unnamed locality close to Mamoro River (Ankitokazo Basin, Ambilobe region).

Geological age: Lower Triassic (Olenekian).

Occurrence and measurements: one specimen preserved as inner mould, 12 mm long.

Description. Carapace shield subcircular in outline as long as wide, slightly vaulted in cross section with strong papillose surface (Fig. 4) close to optical notch on right margin of carapace and with thin granulate papillose surface on submarginal rim. A well developed submarginal rim (Fig. 3) extends along the quite margin of the carapace just below the optic notches that contain lateral rounded eyes (Fig. 4). A wide, undulate, anteriorly truncated rostral plate extends forward from anterior margin of carapace, bearing four? rounded bosses (Fig. 4). Frontal margin with small central rostrum (Fig. 4). Dorsal surface of carapace shield with an anterior post-optic bulge extending in subtriangular gut in median and posterior parts (Fig. 5). In this area, a subrectangular structure (Fig. 6), poorly preserved, broken along median line, has thin undulate ornamentation on surface of plates (this structure, basal upon the shape and location, could be interpret as traces of probable mandibular plates). Dense arrangement of subparallel gill lamellae (not radiate) in the right part of the carapace shield and strong body segments in the left part (Fig. 4) of the carapace shield in MSNM i26555b (the dense arrangement of subparallel gill lamellae was observed before preparation of a cast in order to elucidate the anatomical parts in three-dimensional way, useful in preparing a line drawing reconstruction of the species; the silicon rubber has destroyed the dense lamellae in the right part, revealing the same body segments of the left part). Both structures lie in a U-shaped chamber formed by the body wall and carapace shield (Fig. 3). The specimen does not preserve antennules and antennae. Maxillae, smaller than the maxillipeds, with delicate triangular uncinata distal extremity, are directed forward the frontal rostral plate (Fig. 4). Very long maxilliped I, incomplete, directed forward. Walking legs incomplete group anteriorly with a row of stout and aligned spines on the proximal segments. Some walking legs are superimposed one on another. The location of the walking legs in the studied specimen does not correspond to their real anatomical location. The preservation of the walking legs anteriorly could be interpreted in two different ways: presence of a light current on the bottom or the studied specimen could be an exuvia. Probable basal segment of the caudal rami are partially preserved inside the carapace shield (Fig. 3).

Discussion. Schram *et al.* (1997) reported the main morphological characters of *Halicyne*: carapace with moderately convex and shield-like outline distinctly truncated anteriorly and either slightly acute or distinctly pointed posteriorly, with distinct optic notches, anteriorly articulated to a separate rostral plate; geniculate maxillae modest to small in size; first two thoracopods at least modified as maxil-

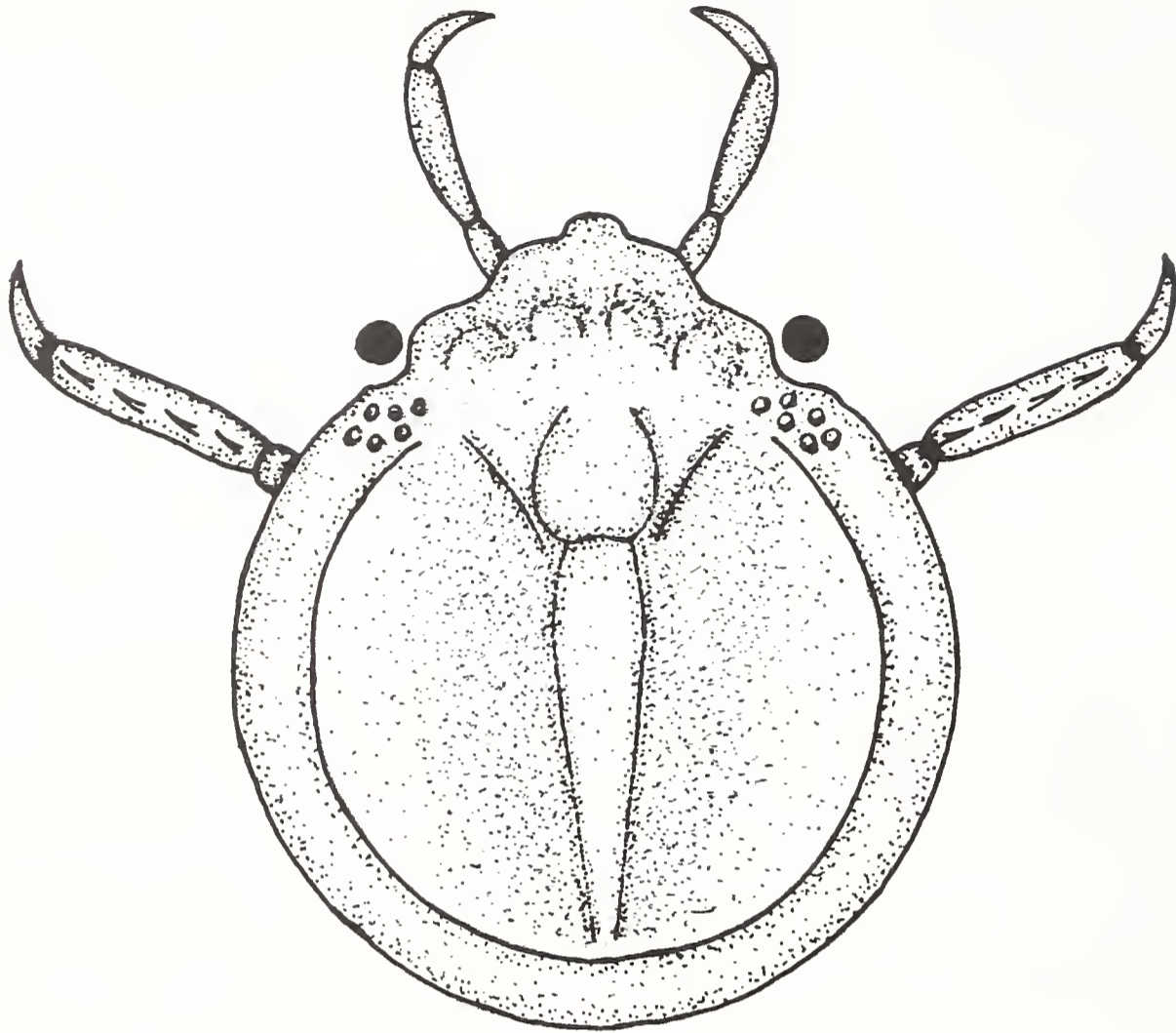


Fig. 1 - *Halicyne mamoroi* n. sp., interpretative reconstruction (ricostruzione interpretativa) (the walking legs II-V were not reconstructed because they are incomplete) (gli arti locomotori II-V non sono stati ricostruiti in quanto incompleti).

lipedes, post-maxillipedal thoracic legs directed laterally and anteriorly; underside of carapace in thoracic region marked by densely packed transverse rugae or lamellae.

The studied specimen shows some characters, such as moderately convex carapace, shield-like outline distinctly truncated anteriorly, optic notches distinct, small central rostrum, first two thoracopods modified as maxillipedes, legs directed laterally? and anteriorly, and underside of carapace marked by distinct rugae and lamellae in thoracic region, typical of *Halicyne*, thus justifying its assignment to this genus. Brambilla *et al.* (2002) described *H. gondwanae* from Ankitokazo Basin, re-described by Pasini & Garassino (2003) on a new specimen. *Halicyne mamoroi* n. sp. differs from the other Malagasy cyclid in having a different shape of the frontal plate with a small central rostrum, a strong papillose surface of carapace shield, four? strong rounded bosses, a different shape of the anterior post-optic bulge extending into subtriangular gut in median and posterior parts, and presence of a well developed submarginal rim.

Moreover, *H. mamoroi* n. sp. differs from *H. agnata* (v. Meyer, 1844), ?*H. plana* (Müller, 1955), and *H. ornata* Trümpy, 1957, in having a different shape of the carapace shield, pointed in the last three species, and above all from *H. ornata* for the different size, length, and ornamentation of the walking legs. The new

Malagasy species differs from *H. max* Schram, Vonk & Hof, 1997, in exhibiting different ornamentation of the carapace shield, different shape of the median gut, and absence of serrate margin of the carapace shield. Finally, *H. mamoroi* n. sp. differs from *H. montanaensis* Schram, Boere & Thomas, 2005, by having stronger ornamentation of the carapace shield, thinner walking legs, different shape of maxillipedes, and lack of evident outer caudal rami. At the same time, *H. mamoroi* n. sp. shows some morphological affinities with the other species: the presence of a raised pattern of bosses on the dorsal surface of carapace (see *H. agnota*, *H. plana*, *H. ornata*, and *H. montanaensis*) and the rounded posterior part of the carapace shield (see *H. gondwanae*, and *H. max*). Moreover, the walking legs of *H. mamoroi*



Fig. 2 - *Halicyne mamoroi* n. sp., holotype (olotipo), n. cat. MSNM i26555 (x 5.5).

are thin and elongate, as also seen on *H. max* and *H. gondwanae*, probably located along the anterior part of the thorax as in *H. max*.

The study of the Malagasy species, compared with the other species of *Halicyne* prompts to five considerations:

- the presence of two different types of walking legs, elongate and thin (*H. max*, *H. gondwanae* and *H. mamoroi* n. sp.) and short and stout (*H. ornata* and *H. montanaensis*) could indicate a different life habit in the same environment;
- the European Triassic species show three morphological affinities of the carapace shield: pointed posterior part, strong ornamentation in the anterior part, and submarginal rim. These affinities could suggest a review of the European species, possibly referable to one single species;
- the Malagasy species were not discovered with associated plant remains, as were American cyclids reported by Schram *et al.* (1997);
- the supposed rarity of *Halicyne* in the Malagasy faunal assemblage is probably due to the kind of field research, usually directed toward collection of larger vertebrates (e.g. fishes) and not to a true rarity of this genus, which may be distributed along the entire extent of Ankitokazo Basin (Fig. 7);
- at present *H. montanaensis* is the only species having evident caudal rami, despite the report by Schram *et al.* (2005) who also observed these structures in *H. gondwanae*. Since Brambilla *et al.* (2002), and Pasini & Garassino (2003) did not observe these structures on the Malagasy species, probably Schram *et al.* (2005) interpreted walking leg V as caudal rami.

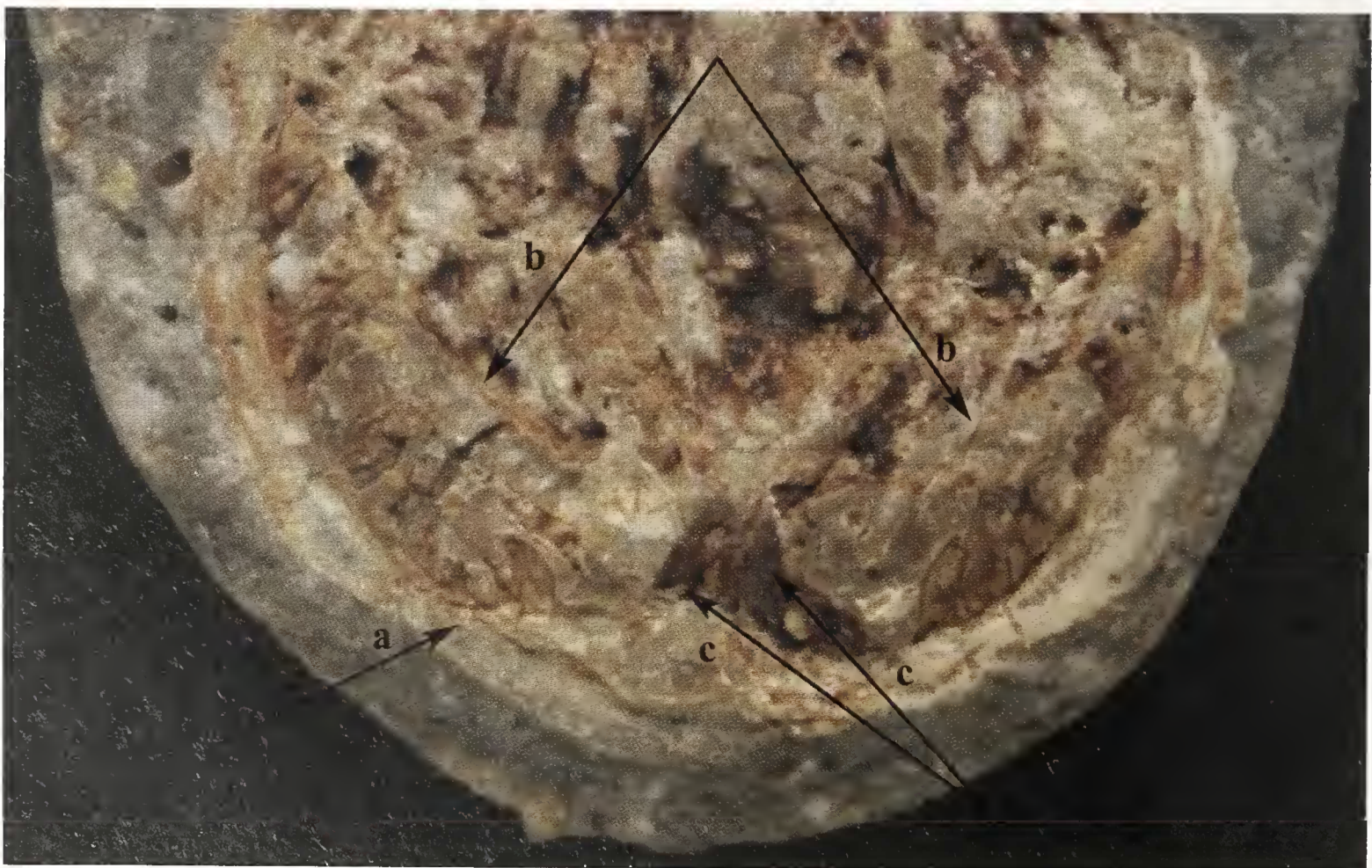


Fig. 3 - *Halicyne mamoroi* n. sp.; a) submarginal rim (piega submarginale); b) U-shaped chamber formed by the body wall and carapace shield (camera a forma di U formata dalla parete del corpo e dallo scudo del carapace); c) probable basal segment of the caudal rami (probabile segmento basale dei rami caudali).

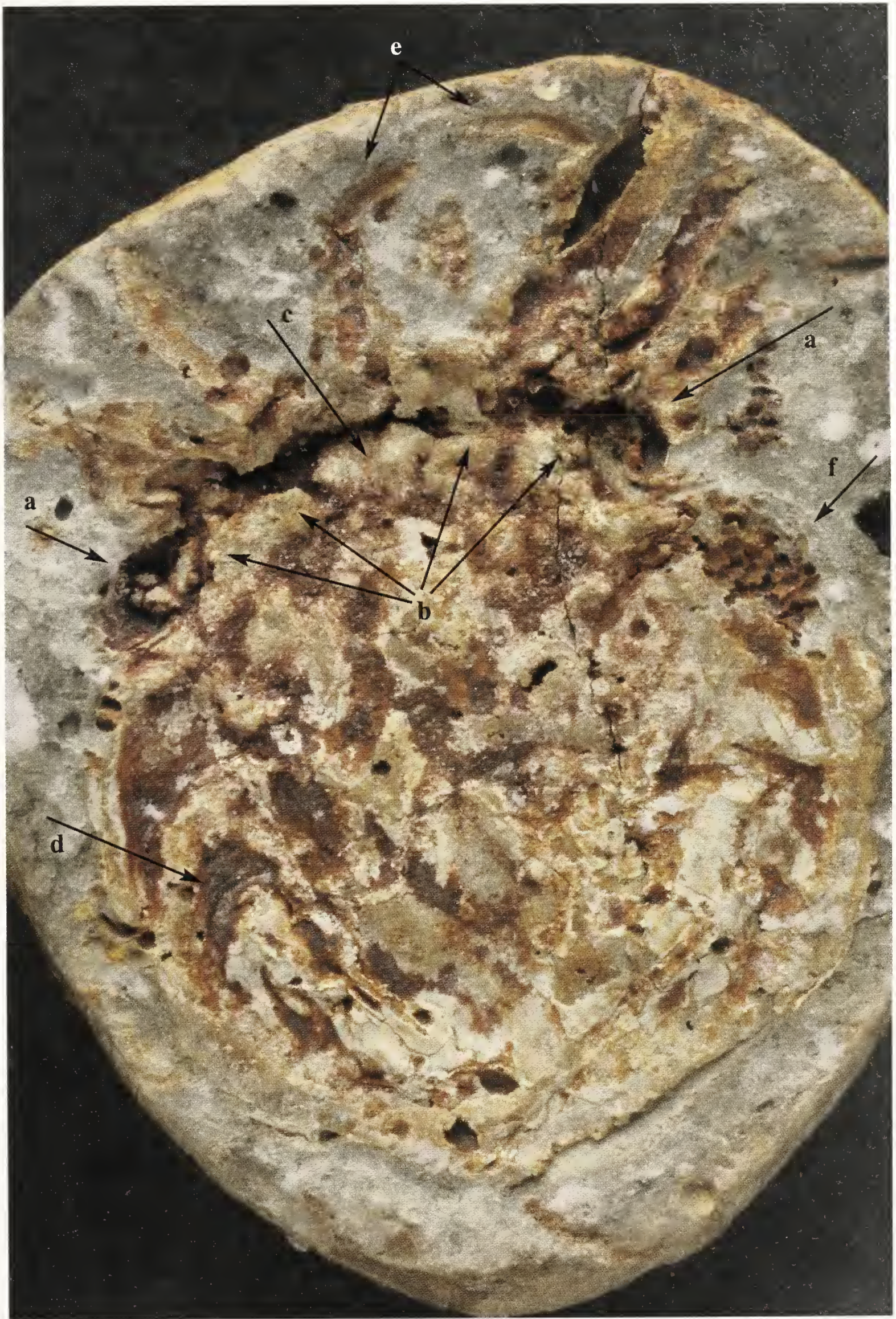


Fig. 4 - *Halicyne mamoroi* n. sp.; a) lateral rounded eyes (occhi laterali arrotondati); b) four? rounded bosses (quattro? protuberanze arrotondate); c) small central rostrum (piccolo rostro centrale); d) strong body segments (robusti segmenti del corpo); e) maxillae; f) strong papillose surface (robusta superficie papillosa).



Fig. 5 - *Halicyste mamoroi* n. sp.; a) subtriangular gut in median and posterior parts (intestino subtriangolare nelle parti mediana e posteriore).



Fig. 6 - *Halicyne mamoroi* n. sp.; a) probable mandibular plates (probabili superfici mandibolari).



Fig. 7 - Geographical map of NW Madagascar and distribution of cyclids in Ankitokazo Basin (mappa geografica del NO del Madagascar e distribuzione dei ciclidi nel Bacino di Ankitokazo): +) *Cyclus madagascariensis* (Mahatsara locality close to Ifasy River) (località di Mahatsara in prossimità del fiume Ifasy); *) *Halicynne gondwanae* (Mahatsara locality close to Ifasy River; Ambitambonoagna locality close to Anjavimilay village) (località di Mahatsara in prossimità del fiume Ifasy; località di Ambitambonoagna in prossimità del villaggio di Anjavimilay); #) *Halicynne mamoroi* n. sp. (unnamed locality close to Mamoro River) (località senza nome in prossimità del fiume Mamoro).

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